TOWARDS EFFECTIVE INTEGRATION OF VIRTUAL DESIGN STUDIO IN ARCHITECTURAL EDUCATION: A PEDAGOGICAL FRAMEWORK

A SYNOPSIS

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1. INTRODUCTION

Architecture remains a constantly evolving discipline shaped by societal changes, technological advancements, and unforeseen global events. Traditional approaches in architecture studio pedagogy have undergone a phased transformation to address the dynamic nature of architectural practice. This research delves into the on-going transitions within academia, seeking to enhance comprehension of architecture studio pedagogy. Central to this exploration is the emergence of innovative and transformative studio discourse, specifically focusing on the paradigm shift towards virtual design studio-based pedagogy. This shift, accelerated by the profound influence of the COVID-19 pandemic, has compelled educators and institutions to reimagine and adapt their teaching methodologies. As the pandemic prompted an unprecedented reliance on digital tools and remote collaboration, the study seeks to unravel how virtual design studio-based pedagogy has been embraced as a responsive and dynamic approach to architectural education in architectural studios. Through gathering direct feedback from architecture school heads, faculty, and students, the research endeavours to comprehensively explore the multifaceted aspects of virtual design studio instruction. Elaborate upon these inferences and insights to formulate a pedagogical framework for the effective integration of virtual design studio into architectural education. Furthermore, the research strives to anticipate the future trajectory of architecture studio pedagogy in the aftermath of the COVID-19 pandemic. In summary, this study aims to enhance the broader discourse on architecture studio pedagogy. Through a critical examination of the transformative journey that architecture studio pedagogy is undergoing, ensuring its continued relevance and effectiveness in shaping the architects of tomorrow.

2. LITERATURE REVIEW

The architecture design studio serves as the crucible in which aspiring architects are shaped. It is the fundamental environment where emerging professionals cultivate their coveted creative abilities, essential to the field. This is evidenced by the significant amount of time dedicated to teaching architectural design and the importance attributed to the design studio by both students and faculty members, Salama [1].

The incorporation of the design studio into architectural education traces back to the influential Academie d'Architecture. Over time, significant changes occurred in the

classical atelier system of the French Royal Academy of Architecture, resulting in the establishment of the Ecole des Beaux-Arts. Within the Beaux-Arts program, the atelier system sought not only to refine students' artistic talents but also to foster their analytical and structural thinking skills, Drexler et al. [2].

As the evolution progressed, the studio transformed into a learning environment analogous to the personal and creative spaces of artists. Notably, the historical narrative of architectural training highlights the crucial roles played by pupillage and workplace learning. During this period, architectural education largely remained under the purview of practicing architects. The prevalent method involved a pupillage system supplemented by evening classes, Howarth [3].

Over time, the traditional master-apprentice approach in architectural education transitioned to a progressive institutional instructional format, with the Bauhaus School playing a pioneering role in interdisciplinary innovation. The Bauhaus School, founded in 1919, introduced an architectonic approach, diverging from the École des Beaux-Arts by fostering three-dimensional perception, creativity, imagination, and personal expression in students. The Bauhaus is commonly acknowledged as a pivotal modernist school of the 20th century, playing a substantial role in shaping educational practices and influencing the intricate relationships between art, society, and technology globally, Barac [4].

Despite the significant influence of the interdisciplinary Bauhaus School and various critical design approaches in the late 20th century, the design studio remains central to the curricular framework of architecture schools worldwide. It continues to be regarded as the standard practice for architectural design education, Pasin [5].

In contrast to traditional classroom settings, design studios are dynamic environments where students actively participate intellectually and socially. They transition between various modes of thinking, including analysis, synthesis, and evaluation, across different activities such as drawing, discussions, and model-making, Dutton [6].

Architecture education is strongly linked to pedagogical approaches centred around design studios, emphasizing collaborative and experiential learning. The studio culture encourages students to actively engage in participatory and communicative

processes, fostering connections and discussions with peers and instructors. This collaborative approach stands out as superior to individualistic and competitive learning modes, Emam et al. [7].

They develop procedural cognition, creative acumen, technical knowledge and critical reasoning mannerisms for the development of professional proficiency. A characteristic feature of the architectural design studio is its learning methods, which are rooted in ‘experiential learning’ or learning by doing, Nicol and Pilling [8].

Experiential learning is described as the process whereby knowledge is created through the transformation of experience, Kolb [9].

Many viewed experiential, project-based learning as an optimal method for gaining insight into the intricacies of architectural design. In this context, one could posit that it entails stages of analytical comprehension, critical reasoning, and creative decision-making, Salama [10].

In the 2000s, the perspectives of numerous educators, representing diverse themes and approaches, have surfaced. These include critical inquiry, process-based pedagogy, and the integration of digital technologies, Salama and Burton [11].

Utilizing exemplary projects in introductory-level studios offers a structure for examining how esteemed practitioners aim for a fusion of program/use specifications, conceptual concepts, structural resolutions, and construction systems, Mitchell [12].

To achieve a piece of architecture requires engaging with a process of thinking, drawing and designing, a process that ultimately produces a building. This process begins with an idea or 'concept' that relates to a particular site or context. It further develops (through a 'brief') into a 'form', which will have functions or activities associated with it. This form is then further developed structurally (as a frame or system), and materially (with a 'skin' or 'wrapping'). It is finally realized, framing experiences of light, sound, space...Architecture, as many other design disciplines, starts with concepts or ideas that initiate the creative process of thinking, Farrelly [13].

Several studies have examined the working methods of designers. These studies generally uphold the notion that there exists a unique form of activity inherent to design, distinct from conventional scientific and scholarly endeavours, Cross [14].

The architectural design process is inherently diverse, reflecting the individuality of practitioners. The wide array of approaches is evident in the stark contrasts between architects' works. In architectural competitions, each entry is distinct, reflecting the unique inspirations of the architect. The absence of a single 'correct' answer to a given architectural problem underscores the subjective nature of the discipline. Engaging with architects or studying their work reveals that behind their approaches lie both methodical processes and sources of inspiration, Anderson [15].

Design, so construed, is the core of all professional training: it is the principal mark that distinguishes the profession from the sciences, Simon and Laird [16].

Simultaneously, advancements in technology have had a significant impact on architectural instructional design. The concept of a paperless studio has begun to capture the attention of educators. The objective is to reduce or eliminate reliance on traditional manual design methods and instead cultivate new design techniques rooted in the creative utilization of digital media within architectural design processes, Salama and Wilkinson [17].

Over time, the concept of the design-build approach has increasingly impacted studio culture, extending the experiential learning process beyond the confines of institutional studios. At its core, prioritizing building is recognized as essential preparation for future professionals. It aims to demystify the construction site and enable students to comprehend the transition of architecture from drawings to actual buildings, Canizaro [18].

Modern architecture practice has evolved into a more collaborative nature, demanding informed professionals. This trend, combined with the advancement of Building Information Modeling (BIM) and the growing prevalence of remote professional collaborations in the Architecture, Engineering, and Construction (AEC) industry, underscores the importance of equipping students with essential skills for online collaboration, Jones and Dewberry [19].

The evolving perspective on the learning environment, combined with a growing emphasis on equipping learners with virtual collaboration skills, has instigated pioneering changes in architecture pedagogy. Significantly, there is a noticeable trend towards embracing and investigating the shift from traditional face-to-face interactions

to a virtual studio discourse format. It's worth noting that the term "virtual" doesn't necessarily imply immersion in a Virtual Environment (VE) at this stage. Instead, students are utilizing quasi-virtual environments through their selection of design and communication tools, Schnabel et al. [20].

The term Virtual Design Studio was coined by William J. Mitchell, (Wojtowicz, 1995) Professor of Architecture and Media Art and Sciences at MIT. The idea of VDS is to create a computer-supported environment for cooperative design, Shao et al. [21].

Since the mid-1990s, virtual design studios have been established globally within the architecture and design field, Wojtowicz [22], Kolarevic et al. [23], Kvan et al. [24]. Broadly speaking, a virtual design studio can be defined as a studio that explores the potential of digital media and virtual environments to extend the boundaries of studio space beyond physical and temporal constraints, Pektaş [25].

In this studio setup, students from various educational backgrounds collaborate seamlessly via an online platform, creating a cohesive design studio experience regardless of their geographical locations. The physical presence of participants becomes irrelevant, as the Virtual Design Studio (VDS) acts as an electronically interconnected workspace. Access to this virtual environment is as simple as being connected to the internet, Donath [26].

The virtual design studio exemplifies a technology-mediated pedagogical arrangement. It leverages both asynchronous (live) and synchronous (recorded) techniques for remote design collaboration. Through the utilization of digital technologies, students develop a deeper comprehension of the evolving modes of collaboration and media integration in design practices. This experience not only enhances their architectural education but also broadens their exposure to diverse design cultures and a wider context of design feedback, Reffat [27].

The shift towards digital platforms in education necessitates the development of a new teaching-learning ecosystem known as e-learning in architecture. E-learning is a multifaceted domain encompassing institutional, individual, technical, and social aspects. The e-learning ecosystem encompasses the environment and all stakeholders involved in e-learning processes learning, Romi [28].

The Covid-19 pandemic has triggered a profound transformation in architecture education, prompting a swift global transition to virtual platforms. This urgency has underscored the importance of examining virtual design studios from a broader perspective and integrating them into local contexts. The incorporation of virtual learning into architecture pedagogy is crucial for fostering effective pedagogical discourse within the current landscape of computer-based distance education. While this shift presents challenges, it also presents opportunities for advancement within the field of architecture, Iranmanesh and Onur [29].

3. RESEARCH PROBLEM

The literature review discusses the significant transformation in architecture education due to the Covid-19 pandemic, leading to a shift towards virtual platforms. This shift necessitates a comprehensive examination of virtual design studios and their integration into architecture pedagogy. Various studies conducted between 2020 and 2022 highlight both challenges and opportunities associated with this transition.

Studies from the United Kingdom, Grover and Wright [30], India, Varma and Jafri [31], Jordan, Alnusairat et al. [32], Turkey, Ceylan et al. [33], Cyprus, Iranmanesh and Onur [34], Australia, Yu et al. [35], UAE, Amro [36], Spain, Kavakoğlu et al. [37] and Egypt, Bakir and Alsaadani [38] provide insights into the experiences, challenges, and benefits faced by students and educators in virtual design studio settings. While some students appreciate the flexibility and access to digital tools, others express concerns about technical challenges, pedagogical effectiveness, lack of peer interaction, and anxiety. Educators also stress the need for improved online instructional content design, teaching methods and integrated platforms.

While we recognise the values associated with studio learning, the integration of technologies is necessary in facilitating different interactions and learning habits. Further studies should consider the impact of VDS on year groups within architecture schools, as well as the application of different pedagogical methods within VDS, Mariotti and Niblock [39].

Additionally, studies from Iran, Asadpour [40], India, Khan and Thilagam [41], and Egypt, Megahed and Hassan [42] propose theoretical frameworks and models for effective virtual design studio pedagogy, emphasizing aspects such as sustainable

design, confluence approach, and blended learning. These frameworks aim to foster interaction, creativity, and learning in virtual environments.

Furthermore, a critical analysis explores the evolution of design education in architecture and urbanism, addressing current challenges and opportunities presented by the pandemic. It identifies process-based and social construction-based pedagogies as strengths and advocates for responsive design pedagogy in a post-pandemic world, Salama and Burton [43].

The literature review underscores the complexity inherent in research surrounding virtual design studios. The research presupposes that to address the same there is a need to deconstruct the virtual design studio discourse into various phases and associated components to enable thorough analysis. Additionally, there is a recognized need for research delving into the practical realities of implementing virtual design studios within specific regional contexts. Moreover, there is a clear need for a universally relevant pedagogical framework for virtual design studio discourse, made up of constituent phases and components, allowing for a deeper understanding and externalisation of the pedagogical process involved. This would enhance understanding and developing the pedagogical process in virtual design studio settings.

In summary, the research problem revolves around the necessity to examine virtual design studios from a broader perspective, at regional settings, and develop a theoretical framework for rational implementation of virtual design studio discourse.

4. OBJECTIVE

- To develop an understanding of architectural design studio approaches.
- To obtain insights on transitions to virtual design studios from regional architecture institution heads.
- To explore role of multidisciplinary domains in teaching and learning within virtual design studios.
- To examine faculty and student perspectives on adapting to virtual design studios during COVID-19.
- To conduct a comparative analysis of faculty and student experiences across physical and virtual architectural design studios.
- To contribute to the existing knowledge of virtual design studio pedagogy.

5. ORGANIZATION OF THESIS

Chapter 1: INTRODUCTION

The introductory chapter focuses on the evolution of conventional design studio pedagogy, particularly its adaptation in response to the challenges posed by the COVID-19 pandemic. Offers insights about the primary focus of the research, which is to comprehend the paradigm shifts occurring within architectural studio discourse and to develop cognition about the difficulties and prospects associated with the adoption of virtual design studio-based approaches.

The research endeavour is guided by a set of research questions, each targeting specific facets of inquiry. The research questions explore various aspects, including the characterization of architecture studio teaching methods, perceptions of architecture institution heads regarding the transition to virtual design studios, contributions of specific disciplines or fields outside of architecture to virtual design studio understanding, differences in faculty and student virtual design studio experiences during the pandemic, insights from comparing physical and virtual studio viewpoints, and the potential expansion of knowledge on virtual design studio pedagogy for design educators.

Formulating a null hypothesis to guide the investigation, the study posits that the virtual design studio, adopted as an adaptive transition-driven approach in architecture studio pedagogy, facilitates a more flexible and adaptable learning environment, leading to improved student satisfaction and academic performance within architectural education. This assumption is juxtaposed against the alternate hypothesis, which suggests that the virtual design studio, adopted as an adaptive transition-driven approach in architecture studio pedagogy, does not facilitate a more flexible and adaptable learning environment, and it does not lead to improved student satisfaction and academic performance within architectural education.

To address these research inquiries and objectives comprehensively, a sequential exploratory design has been adopted as the research design. This approach entails employing a mixed-method methodology, wherein qualitative data analysis informs quantitative data analysis, thereby facilitating an interpretative process to gain an essential understanding of the research phenomena.

Chapter 2: RESEARCH METHODOLOGY

Figure 1. Research Methodology: Implementation Sequence

This chapter discusses about the research methodology, which follows a sequential exploratory design, as shown in Figure 1. Comprising distinct stages and a mixed-method approach to address research inquiries and objectives effectively, beginning with qualitative data collection and analysis, which then informs subsequent quantitative data collection and analysis, culminating in an interpretative process. The research study unfolds in five stages: exploratory research entails a thorough literature survey on architecture studio pedagogy using an inquiry-based approach, followed by an inductive research phase where a focus group study comprising semi-structured interviews with heads of institutions is conducted. Subsequently, another exploratory research phase involves a literature survey across multiple disciplines, utilizing an inquiry-based approach. This is followed by a descriptive research phase employing a survey research method to study sample populations consisting of both faculty and students. Finally, the methodology culminates in a grounded theory-based research phase, where a coding based contextual interpretive process focuses on developing theoretical propositions and future directives. Each stage is crucial, with the initial

phases laying the groundwork for understanding and the subsequent phases delving deeper into investigation and theory development.

This structured approach ensures a comprehensive exploration of the research issue, facilitating a thorough comprehension of the subject matter.

Chapter 3: LITERATURE REVIEW (Architectural Design Studio Pedagogy)

The literature review chapter provides relevant insights, beginning with the identification of adaptive transition-driven approaches in architecture studio pedagogy to address evolving built environment needs and global practice perceptions. This includes classification into critical inquiry-based, process-based, design-build, digital technologies-based and virtual studio approaches. Additionally, the fundamentals of virtual design studio pedagogy are examined, emphasizing the essentials of pedagogy in virtual design studios. Furthermore the scenarios of implementation of virtual design studio at global scale due to the COVID-19 pandemic is explored arising from the rapid adoption of virtual discourse during the pandemic.

As a result of the literature review, the chapter provides a broad understanding of architecture studio pedagogy, outlining instructional approaches and presenting a basic framework chart of pedagogical discourse. It offers literature-based perspectives on the actual implementation of pedagogical strategies and proposes a theoretical grouping of process stages: hosting, implementation and progress appraisal. Furthermore, the exploration focused on comparing physical design studios with virtual design studios, outlining the physical design studio and virtual design studio pedagogical phases.

Chapter 4: FOCUS GROUP STUDY (Heads of Architecture Institutions)

The chapter provides an overview of a focus group study, constituted by heads from architectural institutions associated with a regional university, who participated in a semi-structured interview. Information collected from fourteen Heads of Institutions regarding the conduct of virtual design studios, where they directly supervised teams comprised of core faculties, allied faculties, and visiting professionals in their respective institutions. Insights from these focus group discussions highlight the difficulties experienced throughout different stages: the initiation phase (hosting), realization phase (implementation framework), and reflection phase (progress assessment) of the virtual design model. This emphasizes the significance of tackling

these challenges to ensure the successful implementation and execution of the virtual design discourse.

The findings highlight the importance of breaking down the virtual design studio model into its various potential phases and associated components from a theoretical standpoint. Additionally, it proposes investigating and analyzing the functions of architectural and multidisciplinary fields that contribute to these constituent components.

Chapter 5: LITERATURE REVIEW (Multi-Disciplinary)

The additional literature review delves into multi-disciplinary domains and dimensions, including insights into the virtual learning ecosystem and the prerequisites for developing instructional content tailored to the virtual teaching and learning environment. It also examines the methodologies and processes involved in teaching and learning, along with the assessment of course objectives and goals.

The exploration focus on the domains related to the initiation phase (hosting), realization phase (implementation), and reflection phase (progress appraisal) of the virtual design discourse. As a result of the literature review, the chapter provides a broad understanding of virtual learning and instructional design domains, instructional systems, and pedagogical structure domains, as well as appraisal systems. Additionally, the chapter presents a basic framework for the virtual design studio, stages, parameter classification, analysable activity indicators, and inputs for survey questionnaire framing to facilitate further investigation and understanding.

Chapter 6: VIRTUAL DESIGN STUDIO (VDS) Experience Survey

The chapter outlines a survey research employed to examine user perspectives and insights from both faculty and students regarding their adaptation experience to the virtual design studios amid the COVID-19 pandemic. The study employs a survey research method to study a sample population comprising faculty and third-year B.Arch. students. A cluster sampling technique was employed, whereby 78 faculty members and 250 students were chosen from seven out of fourteen institutions affiliated with a regional university, all adhering to the same curriculum. The sample group possessed experience in both physical and virtual design studios. The sample size was determined with a 95% confidence level and a 5% margin of error.

A well-structured questionnaire, incorporating a Likert scale, was designed to collect insights on various aspects of the virtual design studio experience throughout different phases of implementation. Data analysis and interpretation involved using the Statistical Package for the Social Sciences (SPSS), and the non-parametric Mann-Whitney U-test. The study assesses the effectiveness of measures in teaching and learning, communication, project execution, progress assessment, portfolio evaluation, externalized feedback, and its influence on studio culture within the virtual design studio environment. Key findings suggest variations in adaptation and acceptance levels among faculty and students, emphasizing their involvement throughout distinct phases.

As a result of the study, the chapter unveils distinctions in the levels of adaptation and acceptance observed within faculty and student groups. This comprehension of differences provides essential insight for refining the initiation, realization, and reflection stages in the virtual design studio's pedagogical structure. The exploration focus emphasizes the importance of securing attention, connectivity, and sustained engagement in virtual learning, advising enhancements to continuity and effectiveness by considering the architecture studio framework from both context-centric and individual-centric perspectives.

Chapter 7: PHYSICAL DESIGN STUDIO (PDS) versus VIRTUAL DESIGN STUDIO (VDS) Comparative Study

The chapter outlines a research survey employed to conduct a cross-comparative review and analysis of the experiences of both faculty and students within the architectural design studio, focusing on comparing the physical design studio (PDS) mode with the virtual design studio (VDS) mode. The study employs a survey research method to study a sample population comprising faculty and third-year B.Arch. students. A cluster sampling technique was employed, whereby 78 faculty members and 250 students were chosen from seven out of fourteen institutions affiliated with a regional university, all adhering to the same curriculum. The sample group possessed experience in both physical and virtual design studios. The sample size was determined with a 95% confidence level and a 5% margin of error.

A well-structured questionnaire, incorporating a Likert scale, is designed to collect data on their experiences in physical design studio-based sessions versus virtual design studio settings. Each response to the questions was assigned a weightage,

ranging from 20 (lowest) to 100 (highest) and the response data transformed to a normal distribution scale for analysis. Data analysis and interpretation involved using the Statistical Package for the Social Sciences (SPSS), and the parametric T-test. The study focuses on externalizing experiences, emphasizing involvement throughout distinct phases, including initiation, realization, and reflection. Perspectives and responses of both faculties and students are compared between physical and virtual settings, revealing variations in preferences for PDS over VDS.

The outcomes of the study suggest the need to address difficulties and concerns through proposing a structured and rational pedagogical framework for VDS to increase effectiveness.

Chapter 8: CONTEXTUAL INTERPRETIVE PROCESS

The chapter outlines a grounded theory-based research approach, a coding based contextual interpretive process. The chapter addresses concerns voiced by focus group and survey participants regarding the need for comprehensive insights into envisioning, management, and execution of architectural design studios in a virtual mode.

The research methodology involves a qualitative approach to derive theories directly from collected data, drawing inputs from various sources, including critical insights from precedent and auxiliary interdisciplinary studies, focus group interactions, and survey research,. The process consists of three stages: open coding, axial coding, and selective coding, aiming to extract categories from the data, identify connections between categories, and define the core category, respectively.

The outcomes of the study involve systematic interpretation and integration of interconnected aspects, organized into thematic phases, contributing to the development of higher-level concepts and categories. This fosters the creation of broader conceptual frameworks and categories that embody the intricate relationships inherent in the analyzed subject matter.

Perspectives derived from various interdisciplinary domains offer logically substantiated revelations concerning the pivotal knowledge inherent in the respective disciplines. The chapter concludes by proposing a theoretical framework for discourse in the virtual studio, aiming to provide practical guidelines for educators and contribute to virtual design studio pedagogy, as shown in Figure 2.

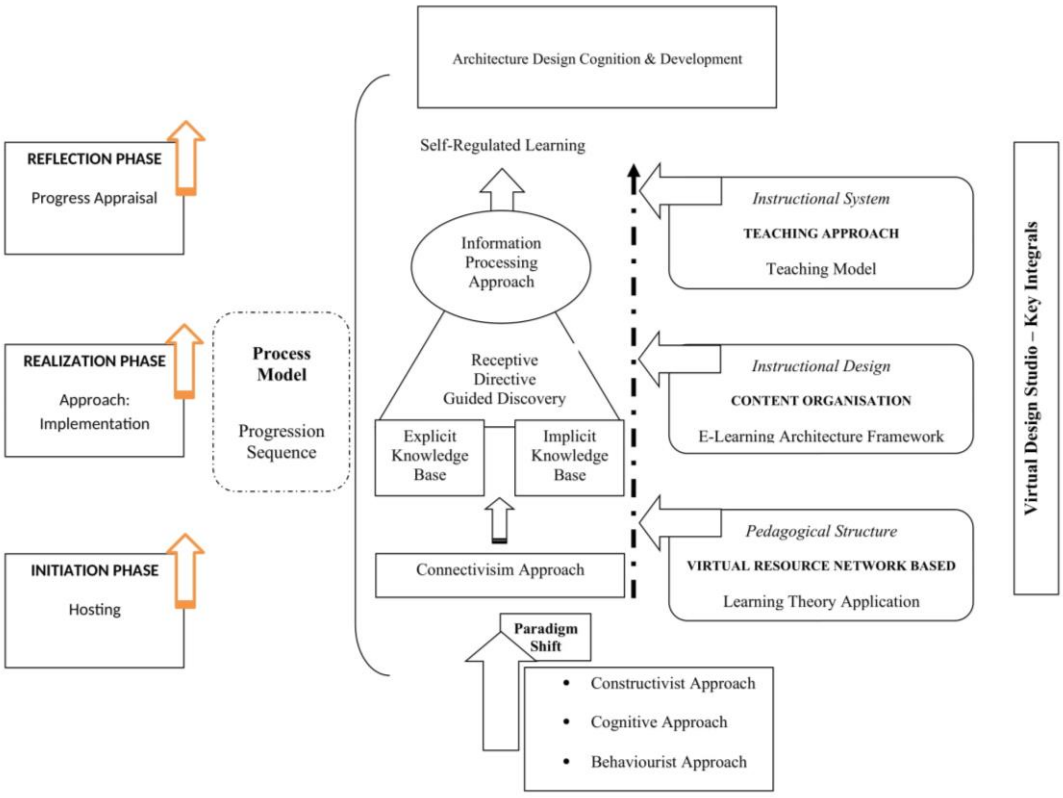

Figure 2. Pedagogical Framework; an instructional process model for VDS

Chapter 9: DISCUSSION AND CONCLUSION

The conclusion chapter offers insights into the discourse surrounding virtual design within architectural studios. Key findings include a synthesis of perspectives from institution leaders, an overview of survey research highlighting adaptation levels among faculty and students regarding virtual design studio (VDS) experiences, Preferential user viewpoints favouring conventional physical design studio (PDS) mode of architectural discourse over VDS approach, as indicated by additional survey data. Hypothesis testing and interpretation based on available inference. Furthermore, this research has led to the development of a theoretical framework for discourse within virtual studio settings.

Contributions to knowledge include a comprehensive understanding of virtual design studio pedagogy, rooted in domains such as information technology, educational technology, the science of learning, and architecture. Practical implications for educators include the development of a virtual design studio pedagogical framework to optimize teaching and learning experiences in virtual settings.

However the study is constrained by factors such as its regional specificity and the on-going evolution of technology. Suggestions for future research include exploring hybrid pedagogical approaches combining virtual and physical learning environments, investigating the relevance of hyflex pedagogical approaches, and examining the impact of emerging technologies like artificial intelligence on architectural education. These avenues could further advance our understanding of architectural design studio pedagogy.

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